# Interoperability in Global Electronic Commerce

Testimony

by

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# Interoperability in Global Electronic Commerce

In less than a decade, the Internet and digital technologies have changed the way we communicate, exchange information, purchase products and services, educate and entertain ourselves and participate in the social and political processes. Electronic commerce, by revolutionizing business-to-business and business-to-consumer transactions, appears to be the leading technological and economic innovation of the 20th century that will determine the future of the global economy in the coming years. To maintain global competitiveness and our leadership in this unprecedented economic prosperity, it is imperative to understand how network and computer technologies impact commerce and economic activities and to act proactively to assure continued progress. This hearing is an evidence of how committed our government leaders are toward such goal and it is my pleasure and honor to communicate to this Subcommittee on the subject of interoperability and the global electronic commerce.

The Internet is by definition a global network. Any business or a consumer with an access to a computer that is connected to the Internet is a global economic player. But this global environment will be of purely theoretical significance if these economic players are unable to communicate and carry out transactions globally because of artificial barriers of technological and commercial nature. An interoperable global electronic commerce system is necessary if we are to maximize potential benefits of digital networking and computing technologies. There are three fundamental advantages of using a global network for commercial transactions and other economic activities. The degree to which we achieve

interoperability in network protocols and commercial applications will determine how different the digital economy of the next century will be from the industrial economy of the past century.

## Economic Benefits of Interoperability

Interoperability and standardization have played an important role in lowering costs and prices, increasing competitiveness, and improving consumer benefits in the physical economy based on industrial production. But they will play an even more critical role in the networked, digital economy which is built upon an interoperable network infrastructure such as the Internet. Before we go into more detail, we may present a list of economic benefits from interoperability:

* Interoperability is one of the key ingredients that allow consumers to substitute one product with another that is manufactured by a different company. This substitutability enhances competition among various manufacturers in the same product market.
* This substitutability and interchangeability implies larger market size, lower unit costs, and lower consumer prices.
* In addition to larger market size, interoperability and standardization enable new market entrants to tap into existing product users. This translates into lowered barriers to entry, further enhancing market competition.

* Interoperability and standardization allow process automation, lowering transaction costs.

The need for interoperability will increase as we focus on process automation. In the Internet economy, businesses and consumers are increasingly dependent on automated, interactive processes using real time Web-based interactions, software agents, and market innovations such as online auctions. An increasing level of personalization in products and services rendered in the Internet economy also implies an integrated economy where manufacturing, distribution, retailing and consumption occur simultaneously in real time. If this vision is what we intend to promote in the global Internet economy, interoperability in products, services and business processes become a key component in any e-commerce system.

## Maximizing Benefits of the Networked Economy

Although the interoperability has played an important role in the industrial economy, its need is magnified in an economy where interactions and exchanges among firms and consumers occur constantly, in real time, throughout the entire stage of the value chain, and with an increasing number of partners. In the physical economy, interoperability is often a simple matter of standards and technological compatibility. For example, two interoperable computers can establish a connection with each other; interoperable word processors may exchange files with one another; interoperable VCRs

can read and play the same video tape; and most electric appliances can operate regardless of who provides electric service or with peripheral equipment produced by a wide range of manufacturers. Without interoperability, computer users will find difficulties in performing simple tasks such as swapping disks and files, or using third party auxiliary equipment, macro programs and extensions.

The Internet-enabled economy goes further than compatibility between manufactured goods. It is based on networks, and the interoperability is a fundamental requirement for an efficient network. From previous experience in telecommunications and transportation economics, researchers are well aware of the economic benefit of interoperability in a network. Through standardization and interoperability, communications software and business applications lower costs for producers and increase user benefits in the form of network externality by which consumers benefit from having one standard product. With network externality, the value of a product goes up as more people have the same product. A typical example is a telephone network where consumption benefits increase as more people join the network (positive network externality). If there are two types of telephone networks, we would be required to have two phones in order to communicate with our friends who might use either of the two telephone systems.

An externality is an effect on costs or benefits that is not accounted for by market mechanisms such as price. For example, there is no market mechanism to require a neighbor to pay for such benefit even if the neighbor gets some benefit from the tree you plant. In this sense, an externality distorts the resource allocation process and creates

market inefficiency. A network externality is an externality related to the number of users (or networks) for a group of products. A negative network externality exists when more users result in congestion, thereby diminishing the amount of total benefits.

Network effects may be direct effects as in the case of telephone, where the issue is whether competing products can be used together (a horizontal interoperability). There are also indirect network effects commonly found in hardware-software platforms in computer, video and audio, and computer games industries, where the issue is whether a complementary product can be used with competing products (a vertical interoperability). Numerous studies have shown that the competition among upstream products (e.g. VHS or Beta video players) critically depends on how many downstream products (video tapes) there are (Katz and Shapiro 1985; Chou and Shy 1990; Church and Gandal 1992).

A horizontal interoperability may be established through cooperation among firms who recognize the benefit of having one standard. But competing standards, although inefficient, often present more choices to consumers than under a mandated standardization. In this case, the market and consumers will determine which becomes the de facto standard. Many components of the Internet communications standards such as TCP/IP, domain name systems, e-mail standards and the World Wide Web, have been developed through consensus and accepted by the marketplace.

A vertical interoperability is somewhat more difficult to achieve since vertically-related products are highly integrated or provided by many vendors. In a typical setup to access the Internet, there may be several layers of vertically related products and applications: PC hardware, operating system software, applications such as an e-mail

client or a Web browser, and communication service including e-mail servers and Internet access providers. All these components are needed to send and receive an e-mail over the Internet. The interoperability in terms of using an e-mail is established by the Internet standards on electronic mail. This guarantees that one on a PC may communicate via e-mail with someone on a Macintosh or a UNIX system. But as application vendors add new features to existing e-mail software, some of these features may not be available to users of different applications. The interoperability will cease to exist.

Vertically integrated hardware-software firms are commonly observed. For example, audio equipment manufacturers such as Sony are selling musical CDs. However, Sony CDs have no inherent advantage over non-Sony CDs in terms of operating (being played) in a Sony-produced CD player. In the computer industry, however, such a seamless interoperability is less common. For example, two competing Web browser applications, Netscape's Navigator and Microsoft's Internet Explorer, are implementing different sets of HTML standards and scripting languages. As a result, Web storefront builders are forced to spend enormous time and effort to accommodate users on different browsers.

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## Interoperability for Complex Organizations and Processes

The need for interoperability in the Internet economy is becoming critical in order to support a growing list of business and social applications of new technologies. A primary example is the use of the Internet for managing supply chain and distribution

which involve a number of suppliers or distributors. An open, interoperable network such as the Internet has provided a cost efficient tool to gain tremendous efficiency in managing multi-partner transactions where multiple trades occur among thousands of participants who may be widely dispersed geographically.

An integrated business operation means more than minimizing transaction costs through process automation. While the latter has been a primary reason for the success of computer-assisted transactions such as electronic data exchange (EDI), electronic fund transfer (EFT) and a variety of initial applications of the Internet network, new Internet applications that connect front-end with back-end operations are aimed at more than simply reducing transactions costs. Their goal is to improve efficiency in product design, manufacturing, and distribution, and to increase choices and satisfaction offered to their customers. Setting up a Web page for suppliers and customers may provide a firm with a cost-efficient alternative to physical stores but, more fundamentally, it enables flexible production methods as well as innovative contracting and selling schemes. Unlike gains in transactional efficiencies, these changes in basic organization and operation of a firm are unique in a networked environment.

For these purposes, data collected from sales outlets can be fed into product research and pricing as well as manufacturing, while supply chain and inventory management activities are ready to respond to changing demands and market conditions. Such a process presupposes that demand data, product information, and transaction data must flow seamlessly among manufacturers, suppliers, distributors, sellers, and their customers. These players may rely on different hardware, software and e-commerce

applications, but they must be enabled within an interoperable e-commerce system.

## Interoperability Supporting Customized Goods and Services

E-commerce market is fundamentally global in the sense not only of its global reach but also of its breaking down product market boundaries. Internet technologies allow firms to overcome physical constraints that often prevent them from doing business with someone across a market boundary. As network and distributed computing technologies advance, killer applications for consumers will be those that allow mixing and matching products and services on a personal basis and in real time. Agent technologies, smart cards and XML all point to an increasing level of customization and integration of products that bundle different products into a distinct item. An interoperable e-commerce system is one that support seamless transactions across product market boundaries as well as across territorial boundaries.

An integrated product is substantially different from bundled products common in physical markets. Bundling usually refers to a quantity bundle that offers a discount when multiple units of a same product is purchased. For digital products, software site licensing may be the closest form of quantity bundling. But most digital products resist bundling as they have no normal wear and tear which force consumers to buy multiple units. A second type of bundling is when similar products are sold as a bundle as in portfolio bundling. Portfolio bundling is common for content sellers. Information buyers, for example, subscribe to a number of news articles which deal with different topics and stock traders

prefer a portfolio of securities. Application software may be subject to portfolio bundling as word processor, graphics program and other software may be bundled.

Another type of bundling is for a combination of products which may be needed for a common task or related in the way we consume. These products may be vertically related. For example, an OS and a Web browser are an upstream and a downstream product which must work together to accomplish a task. Other combinations may be a collection of complementary goods and services. A combination of airline tickets, hotel rooms, a rental car, meals and amusement park admission tickets can be bundled as a packaged leisure product.

Products combined in this manner are often personalized and constitute a distinct product or service taking on an enhanced value from its components. For example, a browser-OS combination may be considered as a new type of software. Stock brokers may integrate market information, company reports, stock trading and financial management into a distinct service. Finding, assembling and personalizing various products for an individual customer would be extremely costly and pose an enormous challenge in pricing and managing in physical markets.

The need for interoperability in technologies is evident if we are to facilitate transactions of goods and services that may involve firms and consumers in traditionally separated markets. In order to support production, trading and consumption of these products and services in an integrated manner, computing and networking technologies must be interoperable with other products, Web pages, payment systems and user interfaces based on different computing platforms as well as different needs and

preferences of users. Developers of next generations of HTML, agent software, mobile networks and smart card applications should also be aware of how technologies change the characteristics of products and consumption behaviors.

## Global Electronic Commerce And Interoperability

Not many of the issues in electronic commerce and the digital economy are local. The internationalization of the Internet goes far beyond the expansion we witnessed in the last century. For most of the 20th century, corporations have operated as multinational entities "knowing no national boundaries." Literally, now we see free trade zones springing up in North America, Europe, and around the Pacific Rim. While these large economic blocks of countries represent the most recent achievement in fostering the free movement of goods, the Internet was created from its inception without borders. For the goods and services that can be ordered and delivered over the network, the Internet is truly a global marketplace.

As political borders cease to be barriers to trade, global electronic commerce has implications that reach far beyond mere economic gains from trading. For example, can nations control the movement of digital goods based on content or isolate themselves from the rest of the Internet? Can governments exercise their regulatory powers on the Internet? And how would the effort to set up a uniform legal and commercial environment for the global electronic commerce affect physical markets?

But these questions assume that the Internet indeed offers an interoperable global

economic market. However, the language barrier itself poses serious challenge to such an open global market. English speakers cannot access Web stores presented in Chinese or German language. Some governments believe that communications on the Internet can be controlled through legal and artificial barriers. For example, through content and access control, minors are protected from obscene and indecent materials (the Communications Decency Act of 1996 in the U.S.); consumers in some countries are protected from "misinformation" and other harmful effects of uninhibited exchange of information; and a nation can even prevent "spiritual pollution" by denying access to Internet sites which contain politically sensitive materials. In other cases, some European governments choose to be isolated by insisting on local languages as the communications standard instead of English, which has become the *de facto* language of the Internet. In this case, languages, not communications protocols, becomes the barrier to interoperability.

Thus interoperability on a global scale is more of a political or cultural nature than a technological or an economic process. Nevertheless, there is a need to have a global, not regional, perspective in securing a workable commercial environment for electronic commerce. Establishing some form of uniform commercial environment is essential in promoting the global electronic commerce. This will imply an interoperability in terms of setting ground rules for commercial transactions over the Internet rather than technological interoperability.

## Interoperability in the E-Commerce Layer

The Internet economy can be divided into several layers in order to categorize and quantify economic activities associated with particular products and services. Barua et al (1999) have identified four layers of the Internet economy in their measurement of the Internet Economy Indicators. The first two Internet infrastructure and Internet applications layers together represent the IP or Internet communications network infrastructure. These layers provide the basic technological foundation for Internet, intranet and extranet applications. The intermediary/market maker layer facilitates the meeting and interaction of buyers and sellers over the Internet. Through this layer, investments in the infrastructure and applications layers are transformed into business transactions. The Internet commerce layer involves the sales of products and services to consumers or businesses. The following table summarizes the four layers and gives examples of firms in each layer.

**Table 1: The four layers of the Internet economy**

| | | |
|---|---|---|
| The Internet infrastructure layer | * | Internet backbone providers (Qwest, MCI Worldcom) |
| | * | Internet service providers (AOL, Mindspring) |
| | * | Networking hardware and software (Cisco, Lucent, 3Com) |
| | * | PC and server manufacturers (Dell, Compaq, HP) |
| | * | Security vendors (Axent, Network Associates) |
| | * | Fiber optics makers (Corning) |
| | * | Line acceleration hardware (Ciena, Tellabs) |
| The Internet applications layer | * | Internet consultants (USWeb/CKS, Scient) |
| | * | Internet commerce applications (Netscape, Microsoft, Sun, IBM |
| | * | Multimedia applications (RealNetworks, Macromedia) |
| | * | Web development software (Adobe, NetObjects, Allaire, Vignet |
| | * | Search engine software (Inktomi, Verity) |
| | * | Online training (Sylvan Prometric, Assymetrix) |
| | * | Web-enabled databases (Oracle, IBM DB2, Microsoft SQL) |

| | | |
|---|---|---|
| The Internet intermediary layer | * | Market makers in vertical industries (VerticalNet, PCOrder) |
| | * | Online travel agents (TravelWeb.com, 1Travel.com) |
| | * | Online brokerages (E*Trade, Schwab.com, DLJDirect) |
| | * | Content aggregators (Cnet, Zdnet, Broadcast.com) |
| | * | Portals/content providers (Yahoo, Excite, Geocities) |
| | * | Internet ad brokers (Doubleclick, 24/7 Media) |
| | * | Online advertising (Yahoo, ESPNSportzone) |
| The Internet commerce layer | * | E-tailers (Amazon.com, eToys.com) |
| | * | Manufacturers selling online (Cisco, Dell, IBM) |
| | * | Fee/subscription-based companies (thestreet.com, WSJ.com) |
| | * | Airlines selling online tickets |
| | * | Online entertainment and professional services |

*Source: Barua et al., 1999.*

According to their measurements, the Internet economy generated an estimated $301 billion in US revenues and created 1.2 million jobs in 1998. Estimates of revenues and jobs contributions by each layer are presented in the next table.

**Table 2: Internet revenues and jobs in 1998, US.**

| | Estimated Internet Revenues (millions of dollars) | Attributed Internet Jobs |
|---|---|---|
| Internet infrastructure layer | 114,982.8 | 372,462 |
| Applications layer | 56,277.6 | 230,629 |
| Intermediary/market maker layer | 58,240.0 | 252,473 |
| Internet commerce layer | 101,893.2 | 481,990 |
| Total | 301,393.6 | 1,203,799 |

*Source: Barua et al., 1999.*

Technical standards and networking interoperability have been key ingredients in the Internet's success as an information infrastructure. Players in the Internet infrastructure layer, providing hardware and software products and services, have demonstrated that the open Internet can be maintained through voluntary efforts toward

establishing technical standards. The real challenge for assuring an open, interoperable Internet economy will be in the applications and Internet intermediary layers. These layers are the basis of business processes and transactions carried out by firms in the Internet commerce layer (i.e. e-business firms). For example, electronic retailers such as Amazon.com rely on software and services to operate their Web stores, and utilize auxiliary Internet services such as Web search, online payment clearing, online auction services and real time distribution support as an integral part of their daily business. Being an Internet business goes far beyond having a Web-based storefront. It means that all of the firm's business processes must be integrated and connected with the rest of the online economy. Augmenting interoperability in the applications and intermediary layers will be a critical factor in achieving a truly digital economy.

E-commerce business interoperability is built upon technological interoperability which provides an open computer and networking infrastructure. However, technological standards at the infrastructure level are relatively easier to reach than those at the applications and business process levels. A few process-level standards have been proposed and defined through worldwide industry players including Open Buying on the Internet (OBI), trading protocols (OTP), and CommerceNet's XML-based eCo e-commerce framework.

But as we move toward setting standards that deal not only with information exchange, transaction and billing automation and payment clearing services but also with trading practices, negotiation, pricing and other market making activities, our effort to standardize and codify these processes will become extremely difficult. Cultural and

practical differences are only one of many pitfalls in trying to establish standards in the applications layer. In addition, time and effort required to reach a consensus among international players and governments may prove to be too slow to support rapidly changing technologies and practices in the Internet economy.

## Cooperation Toward Uniform Commerce Infrastructure

Standards and interoperability in the global e-commerce can be implemented through standard setting efforts by market players. An active role by a government is practically unwarranted primarily because of the nature of the open, global Internet. However, such efforts within the business applications and process layers must account for economic, cultural and legal differences that are prevalent in the physical markets. Corporations and industry groups alone may not be able to overcome such barriers.

Thus, any effort toward global interoperability in electronic commerce must walk the fine line between market-driven solutions and government initiatives. According to the U.S. and the European Union, the principal approach to achieve global electronic commerce is to rely on the market itself (IITF 1996; European Council 1994). But the primary role of governments is to provide a predictable international legal and commercial environment upon which business processes can be standardized and codified. A uniform commercial environment can only be achieved through widespread international negotiation and cooperation. Several exceptions exist in the areas of copyright, key encryption, and electronic contract standards. Even in these areas, the uniformity

underlying these efforts is procedural rather than specific. That is, the goal is to lay a framework within which governments can verify, recognize, enforce, and promote international transactions. Businesses are left to solve the problem of automating and facilitating online transactions.

A uniform commercial environment for the global information infrastructure (GII) must represent both international standardization and national interests to promote economic well-being. The question is whether a uniform law or regulation can avoid having differential impacts on individual countries. For example, using a closed-economy model of trade, countries leverage tariffs and income tax policies to manipulate economic performance. However, a uniform import/export tax—such as no tax, making all Internet transactions duty-free—implies an open international economy which may result in the loss of policy control over domestic economy. Domestic industries are often protected by high tariffs, and a country's balance-of-payment position depends on selectively controlling exports and imports. Simple uniformity may not be acceptable to many countries if it means relinquishing this tool.

There is growing optimism at least in the beginning phase of the international cooperation toward interoperability. For example, recent agreements negotiated by the World Trade Organization lay a solid foundation for global electronic commerce (see attached chapter for details). The urgency to establish an international framework will grow as digital products become the main commodity of the global information infrastructure. Toward this goal, the World Intellectual Property Organization and the Working Group on Electronic Commerce of the United Nations Commission on

International Trade Law (UNCITRAL) have worked toward providing the basic framework to establish the copyrights and legality of digital documents.

## Market-Driven Interoperability and Governments' Role

Within the general and uniform international e-commerce environment, specifics of technical and procedural standardization have to rely on market players. Standardization may be achieved either through standard-setting efforts e.g. by defining and agreeing what features need to be interoperable for everyone's benefit—or through competition. However, leaving standardization entirely up to market players will not guarantee that such an effort will not be anticompetitive. For example, a standard-setting session among competitors may be a disguised conference for collusion. Although market-driven solutions often encourage competition and efficiency without the follies of artificial government intervention, economists and market analysts need to provide clearer definitions and analyses of the effects of interoperability, standardization and dominance on competition, efficiency and economic performance. Governments then need to establish general guidelines as to what type of interoperability and standardization are efficiency enhancing.

A vigorous enforcement to prevent industry collusion may in fact discourage standard-setting activities (Lemley 1996). Alternatively, through competition, one product becomes a *de facto* standard by dominating the market and forcing all others to comply with the product's standards. But, its producer is not obligated to reveal its specifications

unlike the case of industry-wide standard setting. Should governments require that all *de facto* standard products reveal their product specifications to competitors and producers of related products? This will necessarily involve a complex process of guaranteeing profits for the standard-setter, which is far from an improvement over government regulations.

Our experience with the videocassette competition between Betamax and VHS is often mentioned in order to illustrate the market's ability to standardize products. Betamax vs. VHS is similar to having two different sizes for floppy disks. When the VHS became the industry standard, however, it didn't result in only one firm producing VCRs. Under the interoperable standard (i.e. VHS), the healthy competitive market supports numerous competitors and lower prices for VCRs.

Despite this success driven by markets, governments will need to establish a set of regulatory principles. For example, the case of word processing programs or computer operating system (OS) software is fundamentally different from Betamax/VHS standards because the competition in word processing programs or operating system software is not about standards. Instead, it often involves a variety of products that are vertically integrated—e.g. microprocessors, computer hardware, OSs, application programs and contents. In fact, we witness vertically integrated monopolists in a wide range of product markets in the Internet economy because of the very fact that lowering costs often implies integrating software and business processes vertically. Such an integrated business and a dominance by a few integrated software and service providers will become common in the globally networked economy, especially under the assumed economic benefits of network

effects and interoperability. Traditional economic concerns on inefficient monopolists should not simply be abandoned to promote interoperability. Governments' role is to clearly establish a regulatory guideline which promotes both technical and procedural standards and the market efficiency inherent in the Internet-based economy.

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